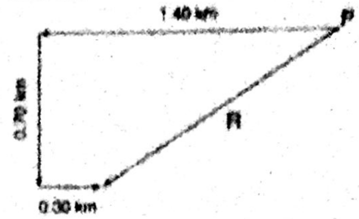
Solutions

Metric Estimation

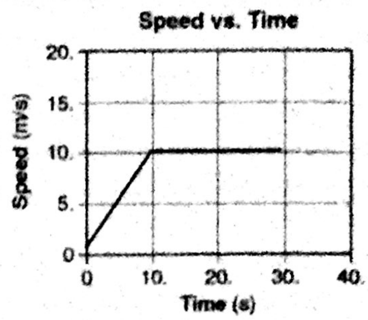
1. 3) 0.01 m
2. 3) 10^3 kg
3. 3) 10^{-2} m
4. 2) 10^1 m
5. 2) 1.3×10^{-4} m
6. 3) 1×10^{-3} kg
7. 2) 1.5×10^{-1} m
8. 2) 10^0 m
9. 2) 2×10^{-1} m
10. 2) 1000 dm
11. 2) 2×10^{-1} m
12. 3) 10^2 m
13. 2) 10^0 m

Kinematics-Defining Motion

1. 1) less
2. 3) 6.0 m/s
3. 1) vector quantity that has a direction associated with it
4. 2) 2.21 s
5. 2) 2.00×10^4 kg
6. 2) 650 km/h
7. 4) average speed
8. magnitude and direction
9. 1 cm = 0.19 m/s
10. vector up and to the right
11. v=1.66 m/s
12. 65°
13. 2) 6m shorter
14. 1) 0.16 km/min
15. 1) 20 m south
16. 4) displacement
17. 5.66 m
18. 1 cm = 2.1 m
19. vector up and to the right
20. 10 m
21. 3) 85 km/h
22. scalars have magnitude only; vectors have magnitude and direction
23. 1
24. 2) 2.5 m/s
25. 3) 15 s
26. 120 m east
27. 4) 83.3 m/s
28. 2) 5.0 m
29. 1) speed is to velocity
30. 1) 2.5 m/s
31. 4) distance
32. 8.6 km
33. 12 km
34. 4) 180 m
35. 3) 3.0 m/s
36. 25 s
37. vector starting at P pointing to the right with length 4 cm
38. 3.6 ms
39. 

40. 0.2 km/min or 3.3 m/s
41. 1.3 km
42. 32°
43. 3) 226 m/s
44. 1) 14 m/s

Kinematics-Motion Graphs

1. 1
2. 10 m/s
3. 

4. 50 m
5. 4
6. 4) 24 m
7. 4
8. 1
9. 50 m
10. 4
11. 1) 0.0 m/s²
12. 3) 40 m
13. 4
14. 1) 12 m
15. 3) 40 m
16. 1.25 m/s²
17. 30 m
18. 15 m/s
19. 2.5 m/s²
20. displacement, distance traveled, etc.

Solutions

Kinematics-Horizontal Kinematics

1. 1225 m
2. vector pointing toward bottom of page with a length of 4 cm
3. 3) 1.5 m/s^2
4. 3) 216 m
5. 3) 44.3 m/s
6. 5.0 cm
7. 1.11 m/s^2
8. 0.167 m/s
9. four evenly spaced dots
10. 2) 2.0 m/s^2
11. 1) 2.5 m/s^2
12. Start at rest and time how long it takes for skater to reach a set distance. Measure distance.
13. $a=2d/t^2$
14. 1) 0.40 m/s^2
15. 1) directed northward
16. 3) 1.2×10^2 m
17. 2.4 m/s^2
18. 19 m/s
19. 2) 1.1 m/s^2
20. 2) 2.2 m/s^2
21. 1) 1.9 m/s^2
22. 2 m/s^2 west
23. 4) 1.5×10^2 m
24. 3) 3.0 m/s
25. 1) 3.5 m/s^2 east
26. 2) 1.5 m/s^2
27. 1) 8.0 m/s
28. 4) 83 m
29. 4) 2400 m
30. 1) 2.5 m/s^2

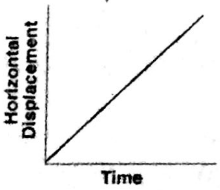
Kinematics-Free Fall

1. make graph
2. make graph
3. make graph
4. 15.5 m/s
5. 4) Acceleration remains the same and speed increases
6. 3) 3.6 m/s^2
7. 2) 7.4 m/s
8. 3) 1.6 s
9. 2) at the end of its first second of fall
10. 3) 44.1 m
11. 3) 3.06 s
12. 2) 15 m/s
13. 3) 47 m
14. 2) 2 s
15. 3) 4.9 m
16. 2) 0.78 m
17. 3) 44 m
18. 1) 0.0 m/s
19. 1) 3.0×10^1 s
20. air resistance
21. 1) 2.9 s
22. 2) 46 m
23. 3) 78.3 m
24. 1) 1.6 m/s^2
25. 3) 10.1 s
26. 2) 4.90 m
27. 2)

Kinematics-Projectiles

1. 1
2. vector up and to the right at an angle of 60 degrees above the horizontal with a length of 5 cm
3. 125 m/s
4. there are no horizontal forces to cause acceleration, as gravity only pulls down
5. 1) the same
6. 3) the same
7. the same
8. $v_{yA} < v_{yB}$
9. parabolic path but lands closer to the base of the cliff
10. 4) 48 m/s
11. 1) 8.6 m/s
12. 1) 3.19 s
13. 4) increase the launch angle and increase the ball's initial speed
14. 16.1 m/s
15. 13.2 m
16. parabolic path with launch and landing angles of 40 degrees above the horizontal
17. 2) Both spheres hit the ground at the same time, but sphere A lands twice as far as sphere B from the base of the tower.
18. 1) v_x=17.0 m/s and v_y=9.80 m/s
19. 2s
20. 4) D
21. 2
22. 6.96 m/s
23. 1.23 m
24. 16 m/s
25. 4.9 m/s
26. 3.7 m

Solutions

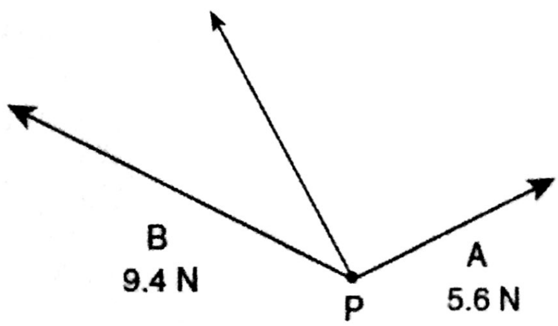
27. symmetric parabolic path with launch and landing angles of 30 degrees above the horizontal
28. increases
29. increases
30. 25 m/s
31. 38.7°
32. 31.2 m/s
33. 2) 100 m/s
34. 3) It remains the same.
35. 3) the same
36. 4) It remains the same.
37. parabolic path
38. 75 m
39. $t = \sqrt{\frac{2h}{g}}$
40. 3) 78 m
41. 2) 45°
42. 2) 9.8 m/s² downward
43. 2) 8.7 m/s
44. 2) 45°
45. 2) Ball A hits the tabletop at the same time as ball B.
46. 1) lower and shorter
47. 3) 63°
48. 3) 15.7 m/s
49. As the launch angle increases from 45° to 60°, time in the air increases and total horizontal distance decreases.
50. 1) v_x=40 m/s and v_y=10 m/s
51. 4) 90°
52. 2) 13 m/s vertical and 7.5 m/s horizontal
53. 4)
54. 4) less than 38 m horizontally and less than 6.7 m vertically
55. 

56. 1.5s

Dynamics-Newton's 1st Law

1. 2) mass of the contents of the box
2. 1) m/s^2
3. 4) A 10-kilogram sled at rest
4. 4) continue moving with constant velocity
5. 3) 10^2 kg
6. 4) A 20-kg mass moving at 1 m/s
7. 4) D
8. 4) unchanged
9. 1) A 110-kg wrestler resting on a mat
10. 3) a seated high school student
11. 4
12. 4) A 20-kg object at rest
13. 1) $kg{\cdot}m/s^2$
14. 4) a 15-kg object at rest
15. 4) a 4-kg cart traveling at 1 m/s
16. 1) a 15-kg mass traveling at 5 m/s
17. 4) a 1500-kg car at rest in a parking lot
18. 1) more mass and more inertia
19. 4)

Dynamics-Newton's 2nd Law

1. 4
2. 4) 4.0 m/s^2
3. 4) a block sliding at constant velocity across a tabletop
4. 2) 600 N
5. 3) 0 N
6. 1) inertia
7. 1) less than the weight of the student when at rest
8. 3
9. 4) 28 N, southwest
10. 1) accelerating upward
11. 2) 5 kg
12. draw arrow down at position X and label
13. draw arrow down at position Y and label
14. 3) 3 N and 4 N
15. 1
16. 2
17. 1
18. 8000 m/s^2 east
19. 1120 N
20. 2
21. 4) 4 N toward the left
22. 3) 9 N
23. 3) both magnitude and direction
24. 1 cm = 2 N
25. 

Solutions

26. 7.2 N
27. 3
28. 9 N
29. 3 N
30. 0.75 m/s^2
31. 1) decreases
32. 2
33. 10 m/s^2
34. 5 N
35. 4) F_H=20 N and F_V=14 N
36. 1) 0°
37. 1.5 N
38. 2
39. 4) 13 N
40. 4
41. 3) 12 N to 2 N
42. 4) 0 m/s^2
43. 3) 600 N
44. 2) increases
45. 4) 600 N
46. 3) 10^0 N
47. 4) 6.0 N
48. 3) a car moving with a constant speed along a straight, level road
49. 1
50. 1) 0.67 m/s^2
51. 4) upward at increasing speed
52. 2) 2.0 N
53. 1) decreases
54. 3) a hockey puck moving at constant velocity across ice
55. 1) 0°
56. 3) a man standing still on a bathroom scale
57. 1)
58. 3) the same as the magnitude of the rock's weight
59. 4) accelerates to the left
60. 1 cm = 10 N
61. draw resultant vector 10cm long at an angle of 37° east of north
62. 100 N
63. 37°
64. 2) 6.0 m/s^2
65. 2) less than 750 N
66. 1) 0 N
67. 3) 5.0 N, down
68. 4)

Dynamics-Newton's 3rd Law

1. 1) 20 N
2. 4) 50 N
3. 2) 100 N
4. 3) the same
5. 4) the same
6. west
7. 1
8. 1) the same
9. 1) F
10. 2) 1.0×10^3 N

Dynamics-Friction

1. 2
2. 850 N
3. 42.5 N
4. 156 N
5. 28 N
6. vector to right of length 2.8 cm
7. 196 N
8. 55 N
9. 7.15 m/s^2
10. 8930 N
11. 12,300 N
12. 9840 N
13. The claim is reasonable since the frictional force can provide 9840 N, and the car needs 8930 N to meet the manufacturer's claim.
14. 52 N
15. 52 N
16. 3) 18 N
17. vector pointing upward of length 2 cm, labeled
18. 6 N
19. 2 N
20. 2 kg
21. 1 m/s^2
22. 2) 10 N
23. 1) dry concrete
24. 3) 12 N
25. 1) left
26. 780 N
27. 7.5 N
28. force of gravity (mg) down, normal force up, equal in magnitude (25 N)
29. applied force of 10 N to the right, frictional force of 7.5 N to the left
30. 2.5 N
31. yes because the net force is not equal to zero
32. 20 N
33. vector beginning at P with length of 2 cm pointing to the left

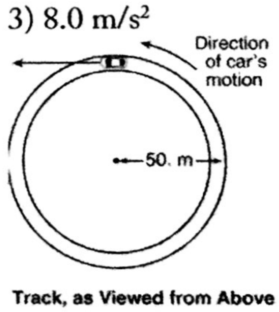
Solutions

34. 0.204
35. 14.7 N
36. 1) 40 N
37. 2) is less than the force of static friction
38. 3) remain the same
39. forces have the same magnitude
40. 3) 40 N
41. 1) less
42. 7500 N
43. 1) 0.24
44. 1) 2.4 N
45. 20N
46. 49N
47. 0.41
48. 1.96 N
49. 0.71 N
50. 3.3 N
51. the block speeds up

Dynamics-Ramps and Inclines

1. 4
2. 2 assuming B remains at the same height; 4 assuming B is at a greater height
3. 3) remain the same
4. 2) 8 N
5. 3) 1.4×10^4 N
6. 3
7. 4) zero
8. 2) 2.1 N

UCM-Circular Motion

1. 1
2. 2) 1.9×10^3 N
3. 1) radius of the path is increased
4. 4) $4F_C$
5. draw arrow toward center of circular path (down)
6. 4) is quadrupled
7. 2) B
8. 2) Hz·m
9. 2
10. 2
11. construct graph
12. T=0.89s
13. g is equal to $4\pi^2$/slope
14. 1
15. 3 m/s
16. 3) 29 N
17. 2
18. 4) 64 m/s^2
19. 2) 12 m/s
20. 3) Increase the radius of the track.
21. 4) east
22. 6.28 m/s
23. 1.1 N
24. 3) C
25. 2) 4.8 m/s^2
26. 1) toward the center of the circular curve
27. 3
28. 3) 8750 N
29. 27.9 m/s
30. draw arrow from A toward center of circle
31. 4.87 m/s^2
32. 2) doubling V and halving R
33. label axes (length on X, period on Y)
34. plot points
35. draw curve
36. 1 s
37. 1) A
38. 4) weight
39. draw arrow straight up
40. radius would increase
41. radius, period, and mass of weights
42. F_g down, F_C toward center of circle
43. 4) 4.0 m/s
44. 3) 2.5 m/s
45. 4
46. 7.8 m/s^2
47. toward the center
48. 3) 8.0 m/s^2
49. 

50. 2.9 m/s^2
51. 3)
52. 1) 0.30 Hz

UCM-Gravity

1. 2
2. 3) 8.17×10^{-10} N
3. 4) 26 m/s^2
4. 1) F
5. 1) 25 N
6. 1) 638 N
7. 1) acceleration due to gravity

Solutions

8. 2) 3.72 N/kg
9. gravity
10. 2.26×10^{17} N
11. The sun has a much larger mass than Neptune.
12. 4) 8.0×10^{20} N
13. 2) 2.00×10^{2} N
14. 3) 100 kg
15. 2) 3.8×10^{7} m
16. 1) attractive, only
17. 2×10^{30} kg
18. 3) one-half as great
19. 4
20. 3) one-fouth as great
21. 6.35×10^{22} N
22. 0.71 m/s^2
23. 3
24. There are multiple correct answers, which may include a kinematics approach in which an object is dropped from rest. By measuring the distance fallen (tape measure) and the time required to fall that distance (stopwatch), the acceleration can be calculated as $a=2d/t^2$. Alternately, a pendulum could be created of length L (measured with tape measure) and its period measured (stopwatch). The acceleration could then be determined from $4l\pi^2/T^2$.
25. 3) 64 times as great
26. 3) 50 N
27. 1) 50 kg
28. 3) 3.00 m/s^2
29. 2) mass remains the same
30. 1) 50 N
31. 2) 2.00 kg
32. 3) 4400 N
33. 4) 19.6 N
34. 1) 20 N
35. 3.6×10^{22} N
36. 2) 2.00 N/kg
37. 2×10^{20} N
38. 4)
39. 1)
40. 2) 5 N/kg
41. 4)
42. 3) 9.8 N/kg
43. 3.53×10^{18} N
44. 2.28×10^{-3} m/s^2
45. Pluto has a greater mass than Charon.
46. 3) 8.3 N/kg

Momentum-Impulse

1. 4) 1.2×10^{5} N
2. 1) 8.0 N·s
3. 2) 2.0 N·s
4. 1) 1 N
5. 2) 2.0×10^{1} m/s
6. 4) 2.4×10^{3} N
7. 50 N
8. 3) applying a net force of 5.0 N for 2.0 s
9. 4) 56 N
10. 1.1 N·s
11. 3) speed
12. 2) 9.9 N·s
13. 4) 0.50 s
14. 6000 N·s
15. 4) greater inertia and the same magnitude of momentum
16. 2) 3.3 m/s
17. 3) 9×10^{2} N
18. 2) 2.0 m/s west
19. 3) 25 N
20. 4) 3.0×10^{2} N
21. 3) 65 m/s
22. 3) 690 N
23. 1) 1.2×10^{2} N
24. 2) 50 kg·m/s
25. 2 s
26. 4) time
27. 0.0060 s
28. 1) increasing the length of time the force acts on the driver
29. 2) 15 kg•m/s
30. 3) 10 N
31. 3) 360 m/s

Momentum-Conservation

1. 3) 3.0 m/s
2. 2.4 m/s
3. west
4. 3) 10 kg
5. 2
6. 3) 3.0 m/s
7. 3) smaller magnitude and the same direction
8. 18.2 m/s
9. 1) 1.5 m/s
10. 3) the same before and after the collision
11. 4) impulse and momentum
12. 2) 2.4 m/s
13. 4.11 m/s

Solutions

14. 23,000 N
15. 4) $m_A v/(m_A+m_B)$
16. 4) $(m/(m+M))v$
17. 3) 0.25 m/s
18. 1) 0.50 m/s left
19. 7.4 kg•m/s

WEP-Work and Power

1. 4) kinetic energy
2. 4) power
3. 3) 12 N
4. 4) 9.0×10^3 W
5. 3) 40 m
6. 1) 100 J
7. 4) J/s
8. 2) greater
9. 2) 280 W
10. 3) 48 W
11. 3) watts
12. 2) distance the box is moved
13. 3) 4,900 W
14. 1) 1 J
15. 2) 30 N
16. 3) 1200 W
17. 1) $kg{\cdot}m^2/s^2$
18. 3) 73 J
19. 1
20. 1) the same
21. 1) impulse
22. 2) power
23. 2) 9.65×10^3 W
24. 3) 570 J
25. 1) 5.0×10^4 W
26. 1) N·m
27. 4) 49 W
28. 7.7 m
29. 128 W
30. 3) 3.6×10^2 J
31. 1) the same work but develops more power
32. power
33. 1) 2.4×10^3 J
34. 3) 27 J
35. 2) 1.5 J
36. 2) 5.0 m
37. 2) 1.5 W
38. 4) 6.0×10^4 J
39. 3) 0.3 J
40. 2) energy
41. 2) impulse
42. 4) four times as great
43. 3) 4.16 m
44. 3) 4.9×10^3 W
45. 1) the same
46. 2)
47. 98 W
48. 3) $kg{\cdot}m^2/s^2$
49. 3) 1.5×10^5 J
50. 2) 9.8 s
51. 1.95×10^4 W

WEP-Springs

1. plot points
2. draw line
3. slope=k=4 N/m
4. 4) 50 N/m
5. 2) 0.5 J
6. 2) 7.5 J
7. k, the spring constant
8. $PE_A < PE_B$
9. 2) 20 N
10. B has the most kinetic energy because all the spring potential energy has been converted into kinetic energy.
11. A has the maximum gravitational potential energy because A is located at the highest height.
12. C because all the kinetic energy and gravitational potential energy has been converted into spring potential energy.
13. 1) 3.6 J
14. 4) 400 N/m
15. 2) larger
16. 3) 120 N/m
17. plot points
18. draw line
19. 0.30 m
20. 0.1875 J
21. 0.96 m
22. 40 N/m
23. 2) 67 N/m
24. 1) 0.18 J
25. 2) 4.0×10^3 N/m
26. 1) 3.75 J
27. plot points
28. draw curve
29. 0.363 J
30. 5.6 N
31. mark scale, plot points, draw line
32. k=slope=55 N/m

Solutions

33. 1) 0.47 J
34. 1) speed
35. 1) 32 N/m
36. $k=mv^2/x^2$
37. 1) A
38. 0.131 m
39. 1.28 J
40. 2
41. 2) 2.0 m
42. 4) 520 N/m
43. 2) 2.0 N/cm
44. 40 N/m
45. 20 N/m
46. 0.9 J
47. 4) 74.9 N/m
48. 2) 15 N

WEP-Energy

1. 2) 200 J
2. 1) quadrupled
3. 2) internal energy, only
4. 2) increases
5. 3) 3.3 J
6. 2) 5.1 m
7. 4) 1920 J
8. 4) joules
9. 5 m/s
10. 750 J
11. 750 J
12. 4
13. 3
14. 1 m/s
15. 3000 J
16. $KE_{after}<KE_{before}$
17. 4) internal energy
18. 11,760 N
19. 7880 N
20. 126,000 J
21. 14.5 m/s
22. 2) 8.00 m/s
23. 1) a decrease in kinetic energy and an increase in internal energy
24. 4) kinetic energy
25. 2) 2.21×10^3 J
26. 3) same
27. 3) position
28. 3) 120 J
29. 3) Internal energy increases.
30. 4
31. 2) 330 J less
32. kinetic energy decreases and internal energy increases
33. 4
34. 63,700 J
35. 19.8 m/s
36. total mechanical energy remains the same
37. 1
38. 3) 30 J
39. 3) remains the same
40. 110 m
41. 46.5 m/s
42. 8.77 m/s^2
43. 4) B and C
44. 3) 72.0 J
45. 4) 9.0×10^3 J
46. 4) kg·m^2/s^2
47. 4
48. 88.2 J
49. 58.8 J
50. G
51. 1
52. 55 J
53. 2.5 kg
54. weight
55. draw a line starting at 0,0 with a steeper slope
56. 4
57. 3) Both elastic potential energy and kinetic energy at t_i are converted to internal energy at t_f.
58. 1
59. 2
60. 1.5 m/s
61. 84.4 J
62. 3) 120 J
63. 4) quadrupled
64. 2) 279 J
65. 2) increases and its kinetic energy remains the same
66. Conservation of energy states that unless work is done on the pendulum, its energy can't increase. The pendulum loses some energy due to air resistance (friction) and friction at the pivot, therefore it cannot return to the previous height on the return swing.
67. 3500 J
68. 10.4 m/s
69. 1) work and kinetic energy
70. 4) $KE=p^2/2m$
71. 1) Lubrication decreases friction and minimizes the increase of internal energy.

Solutions

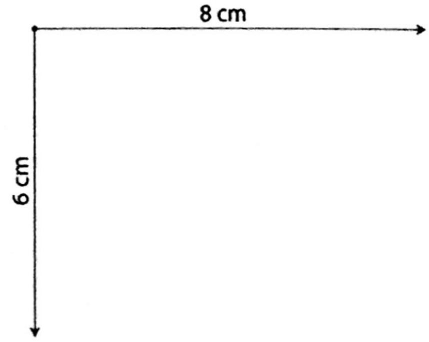
72. 

73. 2) 41 m
74. 1.39×10^{-16} J
75. 4) PE=540 J and KE=1080 J
76. 3) 450 J
77. 3) It remains the same.
78. 4) a boy jumping down from a tree limb
79. 2) 9 J
80. 3) Kinetic energy remains the same and total mechanical energy increases.
81. 3) 5.4×10^3 J
82. 2) mechanical energy to electrical energy
83. 2) 270 J
84. 3) 2.5 m
85. 3) the same
86. 3) 20 m/s
87. 4) 2.0×10^5 J
88. 1) $\sqrt{(2gh)}$
89. 736 J
90. 4) internal energy
91. 3) 110 J
92. plot points
93. draw the curve
94. 70 kg
95. $KE_{soccer\ player} < KE_{runner}$
96. 3)
97. 182 J
98. 120 J
99. KE of the crate is constant.
100. Internal energy of the crate increases.
101. 3) light -> electrical -> mechanical
102. 4) remains the same
103. 3) electromagnetic energy and internal energy
104. 4)
105. 4) 7.50 J
106. 3) The kinetic energy decreases and the gravitational potential energy remains the same.
107. 1) 0.02 J
108. 5.00 N/m
109. Energy is converted into sound/thermal energy, friction, etc. (any of a variety of acceptable answers).
110. 1) speed and work
111. 1) electrical --> mechanical
112. 4) internal (thermal) energy
113. 3) 0.0625 J

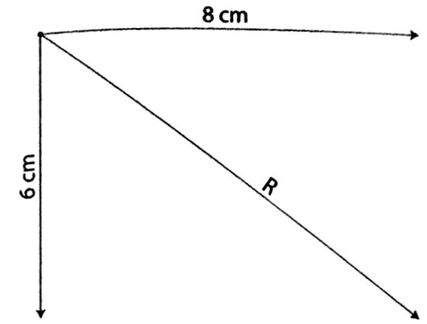
Electrostatics-Charge

1. 1) A, only
2. 3) -3 units
3. 2) 2.5×10^{19} more electrons than protons
4. Bring both positive and negative rods near the sphere sequentially. If the sphere is attracted by each rod, the sphere must be neutral.
5. Bring the positive rod near the sphere. If it is repelled, the sphere must be positively charged.
6. 4) 2.6×10^{-19} C
7. 4) D
8. 3) 6.9×10^{12}
9. 1) may be zero or negative
10. 3) 1.76×10^{11} C/kg
11. 4.8×10^{-19} C
12. 4
13. 4) $+3.2 \times 10^{-19}$ C
14. 2) may be positive or neutral
15. 9.6×10^{-13} C
16. 1) loses electrons
17. 2) 4.8×10^{-19} C
18. 3) 3.2×10^{-19} C
19. 3) electrostatic
20. 1) $+4.80 \times 10^{-19}$ C
21. 4)
22. 2) 3.8×10^{13}

Electrostatics-Coulomb's Law

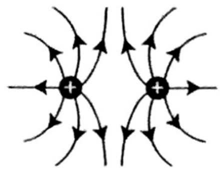
1. 1
2. 3
3. 3) 2.30×10^{-12} N
4. 1
5. 0.9 N
6. 

Solutions

7. 

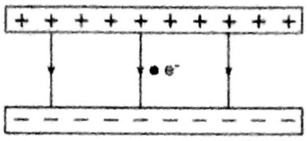
8. 1×10^{-14} N
9. 53.1°
10. 1
11. 4
12. 2
13. 3) 3/4 as great
14. 4) quadrupled
15. 2) 2.4 N
16. 1) stronger and repulsive
17. 4
18. 3) electrostatic forces between the particles of the balloon and the particles of the wall
19. 1) F/4
20. 4) 4F
21. 4) The gravitational force is attractive and the electrostatic force is repulsive
22. 1) $F_g/9$ and $F_e/9$
23. 2) 3.6×10^{-3} N d
24. 1) -3.0×10^{-7} C
25. 1) 2.56×10^{-17} N away from each other
26. 2) 2F
27. 1) F/9

Electrostatics-E Field
1. 2
2. 4
3. 3) 1.25×10^{4} N/C
4. 2.25×10^{4} N/C
5. 1) positively, and the electric field is directed from plate A toward plate B
6. 1) A
7. 4
8. four straight arrows pointing toward negative charge
9. 3
10. 2.4×10^{-19} N
11. 

12. 
13. 4) toward the top of the page
14. 2) 1.44×10^{-6} N/C
15. 1
16. 2) 1.25×10^{4} N/C directed toward the sphere
17. 2) 5.6×10^{-2} N
18. 3
19. 2) Sphere A is negative and sphere B is positive
20. five arrows between the plates pointing straight down
21. 3.2×10^{-16} N
22. 2) toward plate B
23. 3) C to D
24. 3)
25. 2) 2.00×10^{4} N/C directed toward the sphere
26. 3) 9.60×10^{-17} N
27. 2) 4.80×10^{-16} N
28. 3) one-fourth as great

Electrostatics-Potential
1. 1) 1.0×10^{0} V
2. 4) toward the bottom of the page
3. 2) 1.60×10^{-17} J
4. the forces are the same
5. 4) coulomb·volt
6. 2) 12 V
7. 3) electron, because it has the smallest mass
8. 4.0×10^{-15} J
9. 3) 2.5×10^{2} V
10. 4) It is the same at points A, B, and C
11. 2) 2.0 V
12. 4) 2.0×10^{-3} C
13. 3) 3.0×10^{2} V
14. 2) 1.00×10^{7} m/s
15. 5.22×10^{5} V
16. 2) electric field strength
17. 4) a metal sphere with a charge of 1.0×10^{-9} C moved through a potential difference of 4.0 V

Solutions

18. 
19. toward the top of the page
20. 2.4×10^3 N/C
21. force remains constant
22. 1) energy
23. 2) 27 J
24. 3) volt•coulomb
25. 2) 4.80×10^{-19} J

Circuits-Current

1. 2) 2.0 A
2. 4) four times as great
3. 3) 1.6×10^{15} electrons
4. 3) 4.00×10^{-3} A
5. 3) 120 C
6. 2) 2.0 A
7. 2) 5.0 A
8. 30 C
9. 3) 9.1×10^{-2} A
10. 1) 1.0 s
11. 2) 108 C
12. 4) 1.0×10^2 A

Circuits-Resistance

1. 2) gold
2. 2) 2.0 Ω
3. 2) increase
4. The graph is not linear, and the varying slope indicates a varying resistance.
5. 2) increased
6. temperature likely increased
7. mark scale
8. plot points
9. draw line
10. 0.326 Ω/m
11. 3
12. 1) R
13. 6 Ω
14. 2.5×10^{-8} m^2
15. 3) 3.74×10^{-2} Ω
16. 2) increases
17. 1) increasing the applied potential difference and decreasing the length of wire
18. 0.924 m
19. 4
20. R increases
21. 4) 4R
22. 4) silver
23. 4) electric field strength and N/C
24. 3.14×10^{-6} m^2
25. 5.5×10^{-2} Ω
26. 2) 1.4×10^{-1} Ω
27. 1.91 Ω
28. 0.785 A
29. 3) cross-sectional area
30. 3) nichrome
31. 429 Ω
32. 0.0625 Ω
33. 5.6×10^{-8} Ω·m
34. 4) nichrome
35. 3) aluminum
36. 3) decreasing the wire's temperature
37. 1.06×10^{-7} Ω·m
38. 2) 1.12×10^{-2} Ω
39. 1) 7.9×10^{-8} m^2

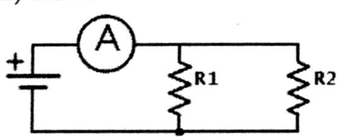
Circuits-Ohm's Law

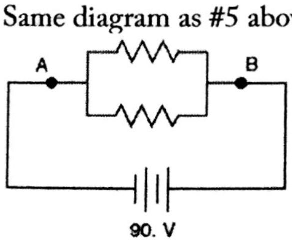
1. 4
2. 3) 10 W
3. 3) 1.44×10^{-4} J
4. 1) current, only
5. 138,000 J
6. 1) decreases
7. 1
8. 2) 0.25 A
9. 4
10. 2) 12 V
11. 2) 2.0 ohms
12. 2) 15.2 mA
13. 3) 9.0×10^3 J
14. 3) 6.0×10^3 J
15. 4) more resistance and draws less current
16. 5250 J
17. mark scale
18. plot points
19. draw line
20. 30 Ω
21. 3) 150 ohms
22. 2) 0.60 A
23. 1
24. 25 Ω
25. 1
26. 4) 1100 W
27. 3) 55 ohms
28. 4) quadruples

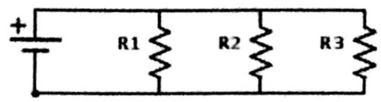
Solutions

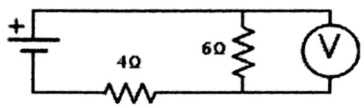
29. 3) 37.4 ohms
30. 1) 1 V
31. 1) half as great
32. 2) BC
33. 2) 240 ohms
34. 1) 2.16×10^4 J
35. 4) 3.6×10^4 J
36. 2) 0.15 W
37. 1) halved
38. 4) electrical potential difference and joules/coulomb
39. 3) is halved
40. 2) 5.76×10^4 J
41. 4) 18 J
42. 16 ohms
43. 4) 4.0 mA
44. 3) 10 J
45. 1) 1.5 eV
46. 2) increases
47. 120 W
48. 4
49. 3) 12 V
50. 2) 15 A
51. 1) 5.67×10^5 J
52. 1) $1.7 \times 10^4\ \Omega$

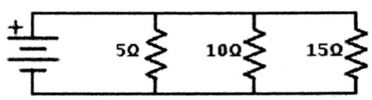
Circuits-Circuit Analysis

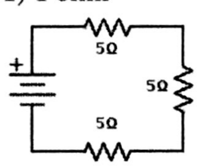
1. 2.4 ohms
2. 4 A
3. 12 ohms
4. 1) 1.0 A
5. 

6. 12 ohms
7. 48 W
8. 1
9. 4
10. Same diagram as #5 above
11. 

12. 90 V
13. 6 A
14. 240 ohms
15. 190 ohms
16. 12.5 W
17. 4
18. 

19. 40.1 V
20. 47.7 ohms
21. 40.1 V
22. 0.11 A
23. 4
24. 

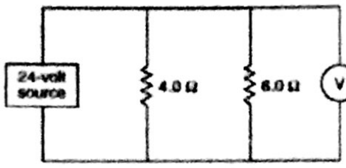
25. 1) 5 A
26. 1) 0.50 A
27. 3) Equivalent resistance decreases and total current increases.
28. 2) 2.0 A
29. 3) 3 ohms
30. 3
31. 

32. 3460 J
33. no effect
34. 3) 32 W
35. 1) 1 ohm
36. 

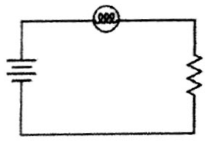
37. 2) 2.0 A
38. 3) 3.0 ohms
39. 4) 4.0 W
40. 1) less than 4 ohms
41. 20 ohms
42. 2) 12 Ω
43. 2) 0.60 A
44. 1) 4.8 W
45. 4) 0.75 A

Solutions

46.



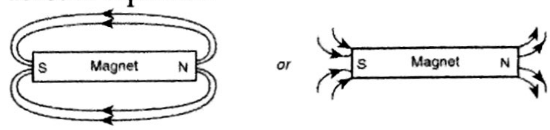
47. 2) 2.4 Ω
48. 2) 9.0 Ω
49. 3) 80 Ω
50. 4
51. 4
52. 3
53. 2) 2 A
54. 3) a voltmeter and an ammeter, only
55. 4) 4.0 A
56. 1) 6.0 A
57. 4) 40 V
58. 1) ammeter at 1 and voltmeter at 4
59. 4) source of potential difference
60. 2) 1.5 Ω
61. 1) The ammeter reading decreases.
62. 2) X/3 Ω
63. 4) 24 V
64. 3) the same
65. 3) 4.62 Ω
66. 2) 2.0 A
67. 1) The potential difference across the 6-oohm resistor is the same as the potential difference across the 3-ohm resistor.
68. 1) 0.018 A
69. 1) less resistance and draws more current
70. same diagram as #5
71. 8.6 Ω
72. 3) 9 A
73. 15 Ω
74. 60 Ω
75.



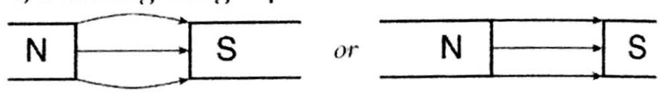
76. 24 Ω
77. 14 Ω
78. 2.5 W
79. 1) varies directly with its resistance
80. 360 Ω
81. no change
82. equivalent resistance would increase
83. equivalent resistance of series circuit is greater

Magnetism

1. 2) moving
2. 3) right
3. 2
4. 3) both an electric field and a magnetic field
5. one is a magnet and the other is a magnetic attractable
6. wire should be moved left and right
7. 2) B
8. 2) increase
9. 1) electric charge
10. 1) The gravitational force is attractive and the magnetic force is repulsive
11. 1) potential difference across it
12. 1) A is a north pole and B is a south pole
13. 1) moving and charged
14. 3) Gravitational force is attractive and magnetic force is repulsive
15.



16. 2) bar magnet
17. 4) a moving charged particle
18.



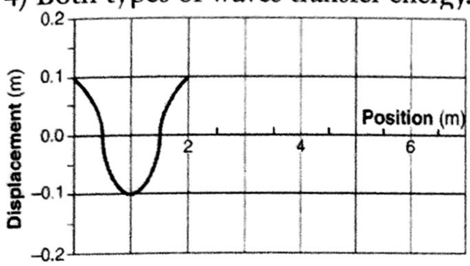
19. 3) both a magnetic and an electric field

Waves-Wave Basics

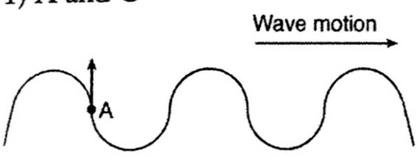
1. 1) sound
2. 4) a pulse
3. 2) down
4. 1) perpendicular to the direction of wave travel
5. 1) energy, only
6. 4) mechanical wave
7. 1) Light waves can travel through a vacuum, but sound waves cannot.
8. 3) The amount of energy a sound wave transmits is directly related to the wave's amplitude
9. 4) transfers energy without transferring mass
10. 2) down, the, up, then down
11. 1) energy, only
12. 3
13. 3) longitudinal, because the air molecules are vibrating parallel to the direction of wave motion
14. 1) light, only
15. 1) Both have the same frequency as their respective sources.

Solutions

16. 1) a pulse
17. 4
18. 1) transverse
19. 1) perpendicular to the direction of wave travel
20. 4) mechanical waves that require a medium for transmission
21. 4
22. 2) A and C
23. 1) amplitude
24. 3.2 m
25. 0.6 m
26. 2) amplitude
27. 4) Both types of waves transfer energy.
28.



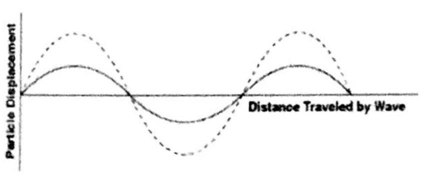
29. 4) sound waves
30. 1) A and C
31.



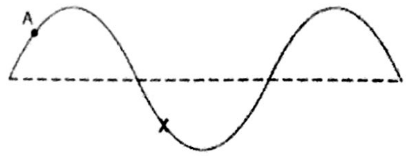
32. 3) loudness
33. 1) vibrate parallel to the direction of the wave's propagation

Waves-Wave Characteristics

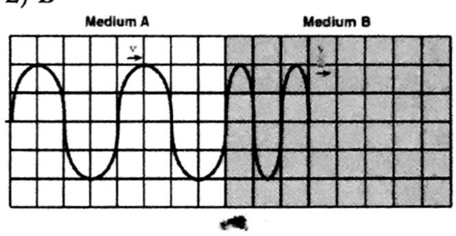
1. 2) 1.29 m
2. 5 m/s
3. 3) 2.5 s
4. 1) halved
5. 0.65 m
6. 3) C
7. 2) 2.0 m
8. 1) Light waves can travel through a vacuum, but sound waves cannot.
9. 2) B and F
10.



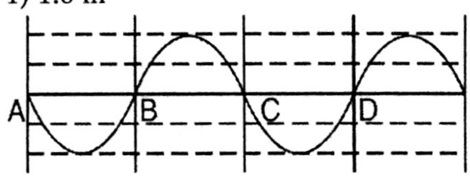
11. 4
12. 3) A and C
13. 1) amplitude
14. 3
15.



16. 1 m
17. 0.5 s
18. 6 m/s
19. 1525 m/s
20. 1.29 m
21. 8.47×10^{-4} s
22. 4) 4.0 Hz
23. 3) remain the same
24. 2) period
25. 4) 4 cm
26. 2) struck harder
27. 2) B
28.



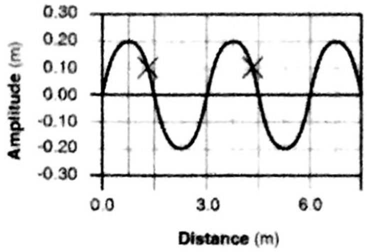
29. 4) amplitude
30. 3) A and E
31. 3) remain the same
32. 4) greater loudness
33. 2) amplitude
34. 2) A and D
35. 2) Hz·m
36. 2) 0.75 m
37. 0.2 Hz
38. 0.4 m/s
39. 3) 8.0 m/s
40. 1) 0°
41. 1) 1.8 m
42.



43. 1) one
44. 2) longitudinal wave of constant frequency
45. 0.509 m

Solutions

46. mark any two points on the wave that are in phase with each other



47. 0.75 s
48. 1) longitudinal wave with air molecules vibrating parallel to the direction of travel
49. 2) They transfer energy.
50. 1) 0.130 m
51. 2) 2 s
52. 1) vibrate east and west
53. 4) D and G
54. 3) 2.5×10^{-2} m/s
55. 3) 1 s
56. 4) 2.94×10^{-3} s
57. 4) 6.7×10^{14} Hz
58. 1) amplitude
59. 2) 0.50 Hz
60. 2) halved
61. 2) twice the amplitude and half the wavelength
62. 4) B and D
63. 1.50×10^{10} Hz

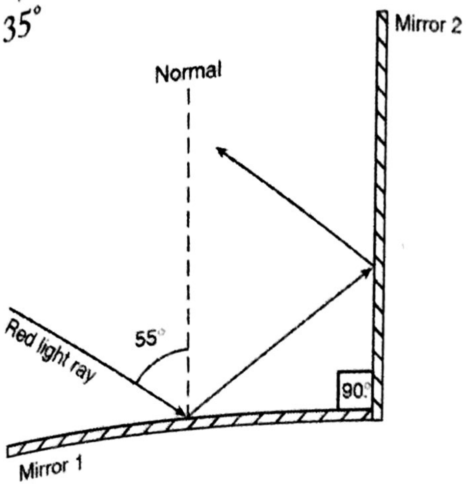
Waves-Wave Behaviors

1. 4) 8.60 m
2. 2
3. 1) resonance
4. 2) higher
5. 2) the same frequency, the same amplitude, and travel in opposite directions
6. 3) 6 nodes and 5 antinodes
7. 4) 380 Hz
8. 4) reflecting from a barrier
9. 1) +1 unit
10. 1) decreases in amplitude and decreases in frequency
11. 1) resonance
12. 2) longitudinal
13. 4) amplitude
14. 1) lower
15. 3
16. 2) a node resulting from destructive interference
17. 3) he accelerates toward the source
18. 4
19. 1) resonance
20. 3) 5 nodes and 4 antinodes
21. 2) the Doppler Effect
22. 2) resonance
23. 2
24. 1) A
25. 3
26. 2) resonance
27. 3 m
28. 60 m/s
29. The singer's frequency must match the natural frequency of the glass; and the singer's amplitude (loudness) must be large enough to surpass the elastic limit of the glass.
30. The frequency of the sound from the tape player would not match the natural frequency of the glass.
31. 4) remain stationary
32. 1.5 m
33. The observed frequency is higher while the speaker is moving toward the observer due to the Doppler Effect, so the observed wavelength must be shorter.
34. 2
35. 3) 0
36. 2) resonance
37. 1) lower, because the sound-wave fronts reach the platform at a frequency lower than the frequency at which they are produced
38. 4) resonance
39. 4) Wave Y must have a frequency of f, an amplitude of A, and be traveling westward
40. 3) $\lambda/2$
41. 3) 180°
42. 3) resonance
43. 2) moving away from Earth
44. 4) resonance
45. 2) wavelength
46. 4) Observer A is stationary, and observer B is moving away from point S.
47. 2) A and D
48. 4) resonance
49. 4) constructive interference
50. 2) frequency
51. 4) 6 cm
52. 2) higher frequency and a higher pitch
53. 3) resonance
54. 4) resonance
55. 4) diffraction
56. 2) lower and the frequency heard by observer C is higher
57. 2)

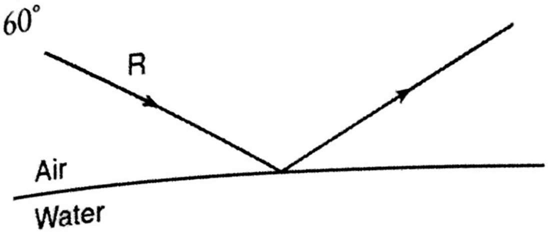
Solutions

Waves-Reflection

1. 3) 120°
2. 3) C
3. 4) all angles of incidence
4. 35°



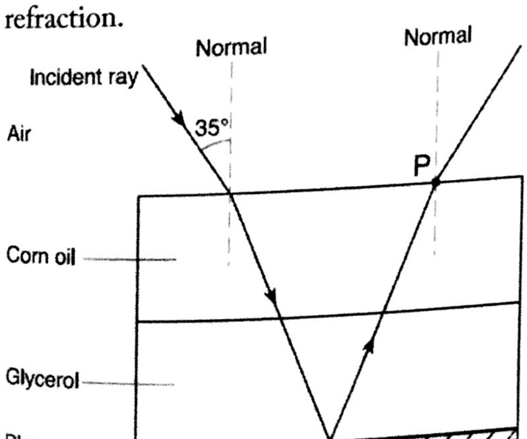
5. 1) 25°
6. 60°
7.



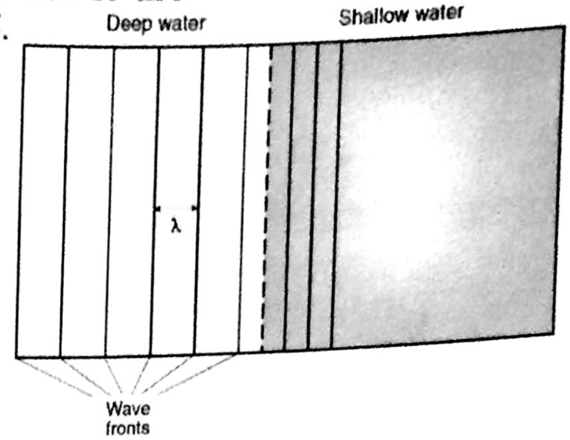
8. 1) A

Waves-Refraction

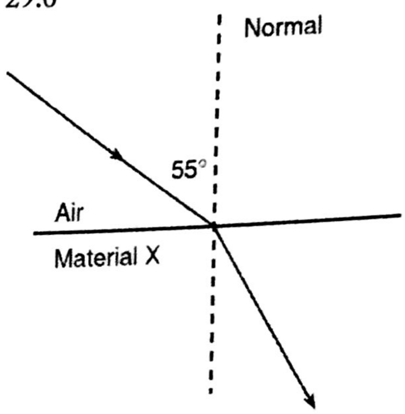
1. 4) Its speed increases.
2. 50°
3. 30.7°
4. 50°
5. 3) wavelength
6. 3) C
7. 4) Light is refracted as it crosses the air-water interface.
8. 23°
9. There is no change in index of refraction, therefore there is no change in wave speed, and therefore no refraction.
10.



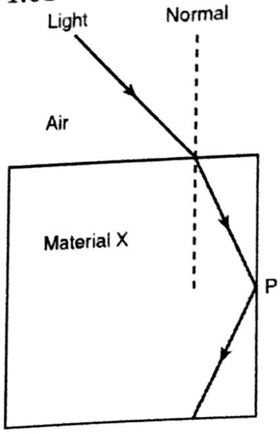
11. 4
12. 40°
13. 1.88
14. 1.6×10^8 m/s
15.



16. 1) the bird and the fish
17. 1.81×10^8 m/s
18. 29.6°
19.



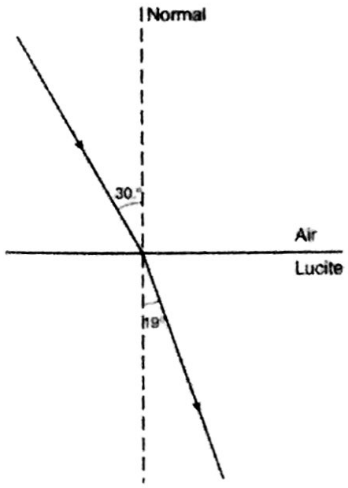
20. 4) equal to 1.66
21. 1.67
22. 2) The speed decreases and the frequency remains the same.
23. 20°
24. θ_1=45°, θ_2=26°
25. 1.61
26.



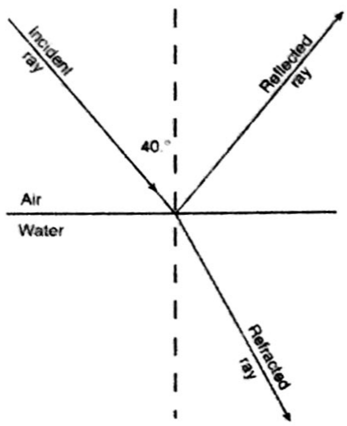
27. 2) doubled

Solutions

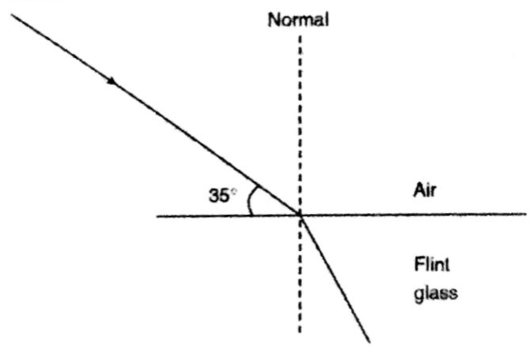
28. 19.5°
29.



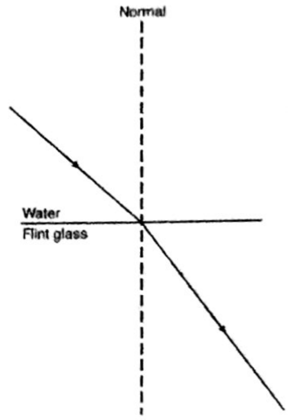
30. 3
31. 2) refraction
32. 28.9°
33.
34.



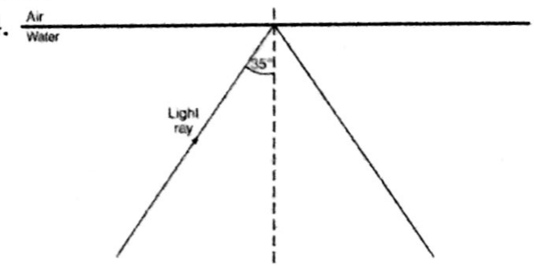
35. 4.01×10^{-7} m
36. 4) 1.50
37. 2) larger
38. 1) Only speed changes
39. 55°
40. 29.6°
41.



42. It is reflected and/or scattered.
43. 2) 16 m/s
44. 1) 3.93×10^{-7} m
45. 2) 1.3
46. 3) 1.75
47. 1) 0.333
48. 3) Medium Y, only
49. 4) speed of light in a vacuum
50. 1) 1.81×10^{8} m/s
51. 4) The frequency remains the same and the speed decreases.
52. 4) speed
53. 1) decreases and its frequency remains the same
54. 4) water (n=1.33)
55. flint glass, corn oil, ethyl alcohol, water
56. 37°
57. 49°
58.



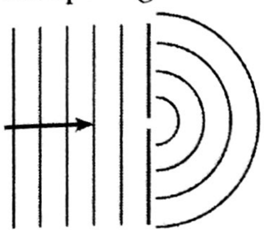
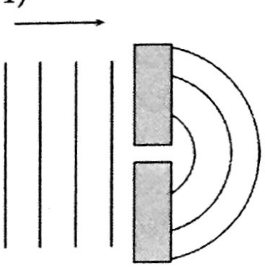
59. reflection, absorption, scattering, decrease in speed, decrease in wavelength, etc.
60. 2) twice the speed
61. 4
62. 4) 2.21×10^{8} m/s
63. 35°
64.



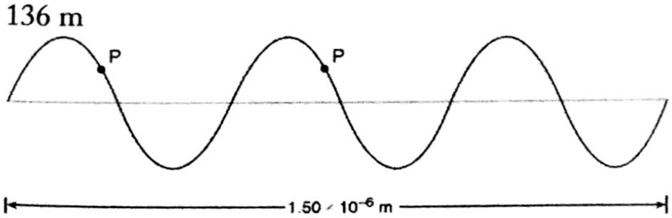
65. 49° or 50°
66. frequency, period, phase, color or transverse
67. 2) frequency and period
68. 2)
69. 2)
70. 4) wavelength
71. 4) glycerol
72. 56°
73. 1.7

Solutions

Waves-Diffraction

1. 1) decrease
2. 4) diffraction
3. 1) diffraction
4. 3) wavelength of the incident wave and the size of the opening
5. 
6. 4
7. 3) long wavelength and narrow opening
8. 1) A
9. 4) have a longer wavelength
10. 1) much shorter than 10 cm
11. 1) diffraction
12. 1)
13. 

Waves-EM Spectrum

1. 2) greater
2. 3) 500 m
3. 2) green
4. 1) speed
5. 1) 5.0×10^{-10} s
6. 3) speed
7. UV radiation has a higher energy than visible light and therefore imparts more damage.
8. 3.28 m
9. violet
10. Yellow-green paint allows the most light to reflect off the truck during daylight hours.
11. 1) speed
12. 136 m
13. 

14. green light
15. 4) speed
16. 2) electric and magnetic fields
17. 1) electromagnetic and transverse
18. 4) 100 μm
19. 1) less
20. 3) 6.0×10^{-7} m
21. 4) 3.00×10^{8} m/s
22. 2) 2.0×10^{-8} s
23. 1) It produces electromagnetic radiation.
24. 1) a radio wave
25. 1) speed
26. 3) speed

Modern-Wave Particle Duality

1. 1) greater energy
2. UV radiation has a higher energy than visible light and therefore imparts more damage.
3. 4.94×10^{-14} m
4. gamma rays
5. 3) both energy and momentum
6. 4) an electron
7. 2) x ray
8. 3) 4.0×10^{-19} J
9. 3) microwave
10. 1) wavelength
11. 2.21×10^{-16} J
12. 1) infrared
13. 1) 6.63×10^{-34} J·s
14. 4.57×10^{14} Hz
15. 3.03×10^{-19} J
16. 1.89 eV
17. 2) diffraction of light passing through a narrow opening
18. 4) $E_{photon} = pc$
19. 3
20. 3) both particles and waves
21. 1) Planck's constant
22. 2) 3.3×10^{-19} J
23. 4) both particles and waves
24. 3) The energy increases and the wavelength decreases.
25. 6.09×10^{-7} m
26. 1) speed
27. 2) electron diffraction
28. 3) both particles and waves
29. 4.53×10^{14} Hz
30. 2.85×10^{-18} J
31. 6.63×10^{-18} J
32. 3.45×10^{-18} J

Solutions

33. mass, charge, momentum, energy
34. 3) 5.10×10^{-19} J
35. 1)
36. 3) 4.14×10^{-19} J

Modern-Energy Levels

1. 2) 8.82 eV
2. the hydrogen absorbing certain frequencies of the white light
3. 1) electrons transitioning between discrete energy levels i the atoms of that element
4. Absorbing a 10.2 eV photon allows the electron to jump from the ground state to n=2, while an 11 eV photon cannot be absorbed because there is no available state 11 eV higher than the ground state.
5. 3) 3
6. 2) 8.81 eV
7. 1.89 eV
8. 3.02×10^{-19} J
9. 4.57×10^{14} Hz
10. 6.56×10^{-7} m
11. 3) absorbed a 2.55-eV photon
12. 3.02×10^{-19} J
13. 1.89 eV
14. This result verifies that the alpha line corresponds to a transition from energy level n=3 to energy level n=2 because the difference in energies between those two levels is 1.89 eV, the energy of the emitted photon.
15. 4) 5.43 eV
16. 3.33×10^{-19} J
17. 2.08 eV
18. n=3
19. 3) The photon's energy is too small.
20. green
21. 3.63×10^{-19} J
22. 2.27 eV
23. 8.69×10^{-19} J
24. 5.43 eV
25. This photon can be absorbed by te mercury atom because an electron in the ground state can absorb a 5.43 eV-photon to jump to energy level d.
26. 1.24 eV
27. 1.98×10^{-19} J
28. 2.99×10^{14} Hz
29. infrared
30. 1) ultraviolet
31. 3) 2.84 eV
32. 3) B and C
33. 2) 9.62 eV
34. 8.82 eV
35. 1.41×10^{-18} J
36. 3.02 eV
37. 4.83×10^{-19} J
38. 7.29×10^{14} Hz
39. No, the electron could jump to other energy levels by emitting photons of other energies / frequencies.
40. 3) 3
41. -8 or 10^{-8} Do not allow credit for 10 nanoseconds or a decimal form such as 0.0000000010 s.
42. 3.16×10^{-19} J
43. The ground state is the lowest available energy level that an atom can have *or* the ground state is the most stable energy state.
44. 2) 0.97 eV
45. 3) n=5 to n=2
46. 3) 1.51 eV
47. energy level f
48. 4.90×10^{-19} J
49. 7.39×10^{14} Hz
50. visible light / violet

Modern-Mass Energy Equivalence

1. 2) 1.42 MeV
2. 3) 4.5×10^{14} J
3. 233 MeV
4. 2) 8.2×10^{-14} J
5. 1) 1.8 TJ
6. 1) 1.64×10^{-13} J
7. 0.042 u
8. 1
9. 4) 9.00×10^{16} J
10. 1) 1.14×10^{-30} J
11. 3) 8.48 MeV
12. some mass was converted into energy
13. 0.01863 u
14. 17.3 MeV
15. 3×10^{-10} J
16. 2) c^2
17. 2) 8.20×10^{-14} J
18. 1.50×10^{-10} J

Modern-Standard Model

1. 4) attraction between nucleons
2. 1) leptons
3. 1) baryon
4. 0 (neutral)
5. 3) baryon to another baryon

Solutions

6. 2) It holds protons and neutrons together
7. 3) cdb
8. 2) +2e
9. $m_{neutron} > m_{proton}$
10. 0 (neutral)
11. 2) baryons
12. 2) strong force
13. antiproton
14. the same
15. charge
16. Although matter is only created in matter-antimatter pairs, most known matter is normal.
17. 1) strong force
18. 3) -1 e and +1 e
19. 1) $+5.33 \times 10^{-20}$ C
20. 3) strong force
21. 2) 12
22. 2) frequency
23. 4) violet
24. -1.60×10^{-19} C
25. 3) 3 up quarks and 3 down quarks
26. 4) electrons
27. -1e -> -1e + 0e + 0e
28. 3) the same mass and the opposite charge
29. 4) electromagnetic
30. 3) 3.2×10^{-19} C
31. 3) proton
32. meson OR hadron
33. +1e OR -1e
34. The particles have enough (kinetic) energy to be converted to that much mass.
35. 2) Matter is converted into energy and then energy is converted into matter.
36. 4) omega
37. 2) hadrons
38. 2) a quark and an antiquark
39. 1) css
40. 4) neutrons and protons
41. 4) 21 quarks and 3 leptons
42. 3) $+1.07 \times 10^{-19}$ C
43. 1) $s\bar{c}$
44. 1) charge must be conserved
45. 2) -1e
46. 1) strong
47. up, down, down
48. -1e
49. 1.60×10^{-7} J
50. 3.56×10^{-24} kg.
51. 1) uud